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SECURITY INFORMATION

Report No. L800-74

Aerjet

ENGINEERING CORPORATION

AZUSA, CALIFORNIA

INFORMAL REPORT OF PROGRESS

Copy No.

17 November 1952

TO: Office of Naval Research
Department of the Navy
Washington 25, D. C.

VIA: Bureau of Aeronautics Representative
15 South Raymond Avenue
Pasadena 1, California

SUBJECT: Research, Development, and Testing
of Underwater Propulsion Devices

CONTRACT: N6ori-10, Task Order I
Project NR 220 003

PERIOD
COVERED: 1 October through 31 October 1952

This informal monthly progress report is
submitted in partial fulfillment of the
contract.

AEROJET ENGINEERING CORPORATION

C. A. Gongwer

C. A. Gongwer, Manager
Underwater Engine Division

NOTE: The information contained herein is regarded as preliminary
and subject to further checking, verification, and analysis.

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SECURITY INFORMATION

I. ALCLO MOTOR

A. DOUBLE-WALL MOTOR USING 3.75-IN.-DIA GRAIN

Testing of grains having 20 and 30% excess aluminum was carried out. The test results with the 30% excess aluminum grains were inconsistent. The performance of the motor with the 20% excess aluminum grains was about the same as the performance using the standard stoichiometric grain.

B. TEST VEHICLE MOTOR USING 3.75-IN.-DIA GRAIN

Testing of the motor fitted with a short combustion chamber was initiated. Because of space limitations in the hydroductor design, a motor of this configuration is desired. The performance of the motor with the short combustion chamber was about 20% lower than that with the standard-length combustion chamber. Several types of turbulators are being designed for testing in the short chamber to effect better mixing.

C. SINGLE-WALL MOTOR USING 4.75-IN.-DIA GRAIN

Fabrication of the major components of this motor was completed.

II. STEAM-INJECTOR CONDENSER

Tests in the past month have indicated that the optimum ratio of diffuser length to throat diameter is between 2:1 and 3:1. On the basis of the many foregoing tests an exact scale model of the prototype unit has been designed; this incorporates optimum design features where possible, and, after fabrication, a thorough evaluation of all performance characteristics is planned. Preparation is also being made for preliminary full-scale tests.

III. ALCLO-FIRED TEST STEAM GENERATOR FOR SUBMARINE

A. The performance of one of the recent burner designs proved satisfactory, and after several tests of firing in the open and within the test furnace, the burner was actually operated under the boiler unit. The steam generator was controlled manually within a pressure range of 75 to 125 psig and a steam temperature up to 550°F, with a steam flow of about 200 lb/hr. The Alclo reaction was kept on for about 8 min. The furnace and steam-generating tubes withstood the heat well.

B. Additional tests will be made before closing the gas recirculatory system.

IV. ALCLO STUDIES

A. PROPELLANT STUDIES

1. Four slow-burning mixtures were made and their burning rates tested at atmospheric pressure. The results are tabulated below, along with figures for standard Alclo.

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Mix. No.	Composition, %					Atmospheric Burning Rate in./sec
	Al No. 606*	Al No. 101†	KClO ₄	Pb	FV‡	
Standard	31.4	—	55.8	12.8	—	0.52
23	—	31.4	55.8	12.8	—	0.052
24	—	32.4	57.7	—	9.9	0.046
25	17.02	17.02	60.6	—	5.36	0.235
26	17.2	17.2	57.7	—	9.9	0.223

* Al No. 606 is flake aluminum

† Al No. 101 is atomized aluminum

‡ FV is ferrovanadium powder

In each of these mixtures the proportion of aluminum metal to oxidizer is stoichiometric. These tests show that the type of aluminum powder used has a profound effect on the burning rate of the mixture.

2. A series of tests was initiated to study the effect of temperature shock on 3.75-in.-dia Alclo grains. For these tests, six consecutive grains (3 pairs) were selected and provided with missile-type base plates and standard igniters. One of each pair was left in normal storage and the remaining three grains were put through a temperature-cycling program in which they were changed from the cold box (-10°F) to the hot box (+140°F), and vice versa, every 24 hr, until five complete cycles were made. These grains will be tested in a test vehicle motor in the static-test pit.

3. As a precautionary measure it has become standard practice to seal the unrestricted surfaces of all Alclo grains, thus preventing exposure to air and moisture. A strippable vinyl lacquer is being used which is easily removed when further processing or testing of the grain is desired.* In order to test the effectiveness of this coating, six 3.75-in.-dia grains were placed in hot (180°F) storage exposed to otherwise normal atmosphere. These grains will be tested in a test vehicle motor in the static-test pit after various periods of storage.

B. 400-TON PRESS

1. Seventy 3.75-in.-dia grains were pressed during the month of October. The grains averaged about 8.25 in. in length and weighed about 9 lb each.

* Naval Ordnance Specification 52-C-41 (Stoner-Mudge Pacific Corporation).

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2. Except for a small delay to make minor improvements in the auxiliary hydraulic system, the press was kept in operation during the entire period covered by this report.

3. The parts necessary to press 4.75-in.-dia grains have been completed and are ready for use.

V. GASOLINE AND COMPRESSED-AIR HYDROPULSE

A. Fairly consistent firing of the motor was obtained with two atomizing injectors installed in the combustion chamber and with the spark retarded. Advancing the spark, even slightly, hampered or stopped combustion. This appeared to be due to incomplete vaporization of the fuel.

B. It was believed that the use of a more volatile fuel would permit test operation with the spark properly advanced. The motor was operated with the same mechanical equipment as before, using Standard Oil Company No. 200 thinner for fuel. Operation was still unsatisfactory when the spark was advanced.

C. A completely different fuel-injection system was built and tested. In an enlarged section of the manifold, fuel was injected in a fan-shaped spray onto a series of wick-type evaporators mounted parallel to the air flow. Fuel was injected continuously, and the injected air picked up vapor as it passed. When tested with No. 200 thinner, the combustion appeared to be better than any attained previously. The reluctance-type chamber-pressure pickup was damaged during operation, and no quantitative data were obtained.